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GB 2268818 A **GB 2237707 A** **US 4651157 A**

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(54) Vehicle security systems

(57) A vehicle security system comprises a control centre 10 and a number of remote radio stations 11 to send and receive message from mobile units 12 mounted in vehicles. The control centre responds to alarm signals at any time and additionally communicates continually at intervals and respective set times with the mobile units to ensure they are operational.

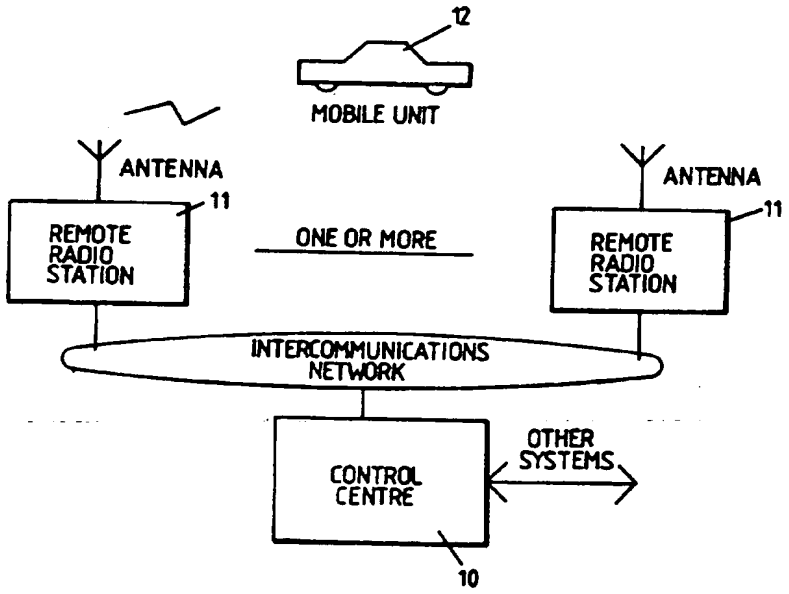

FIG. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

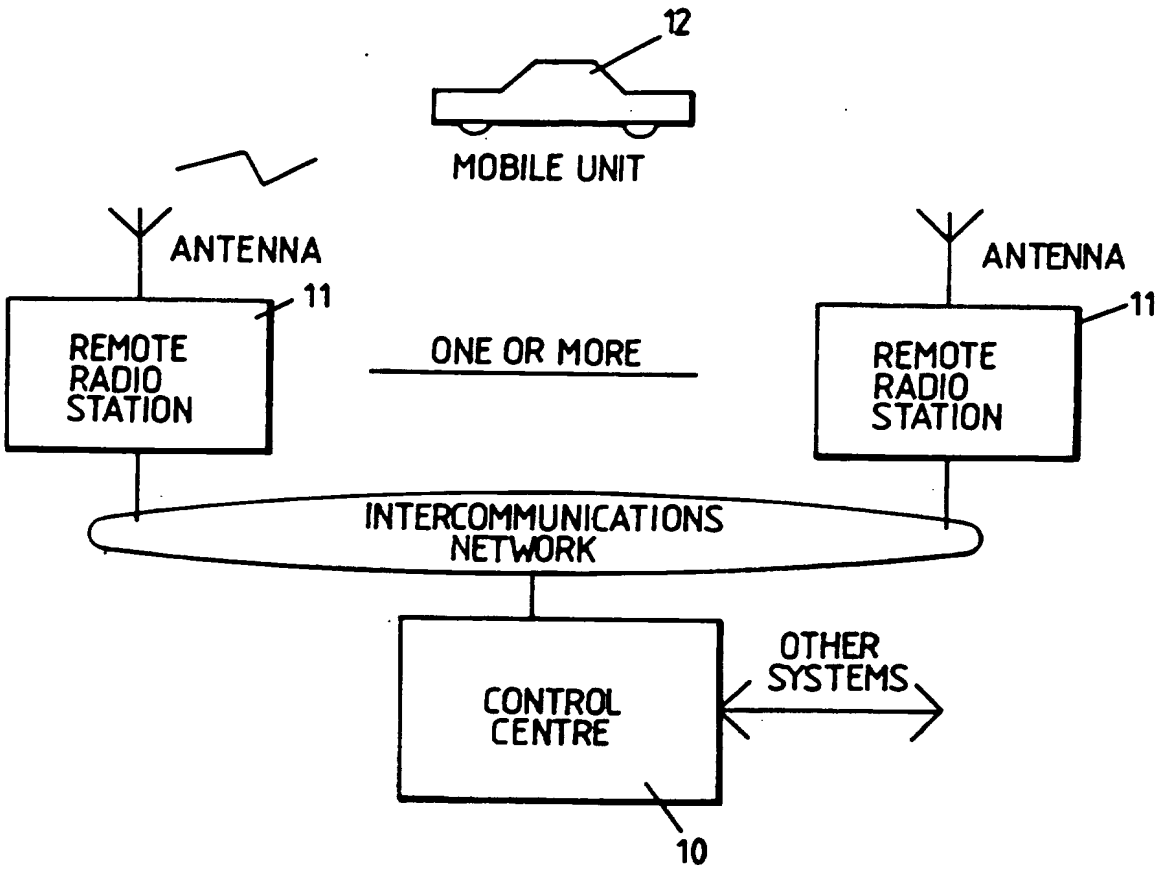

FIG. 1

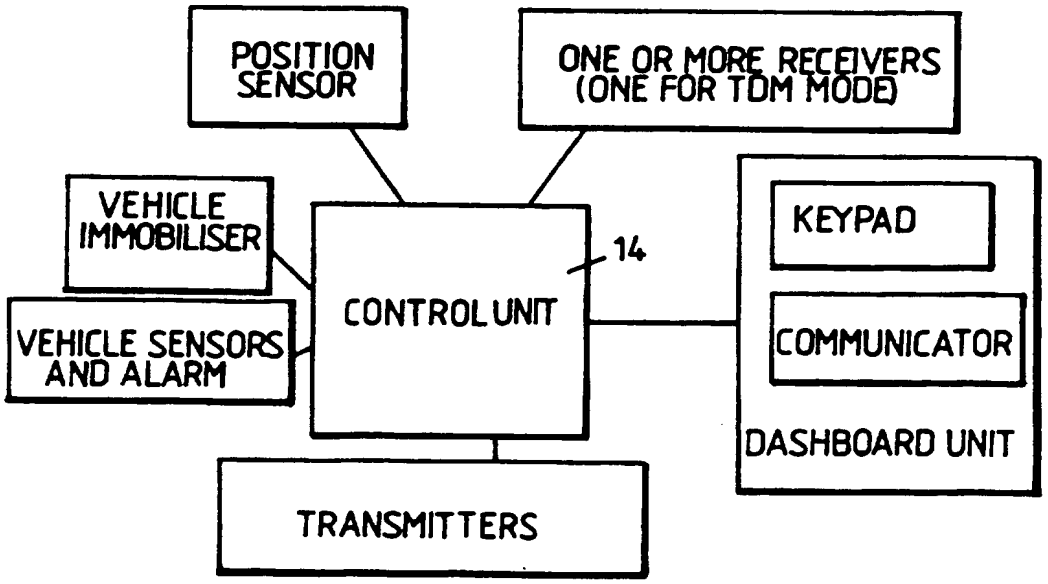

FIG. 2

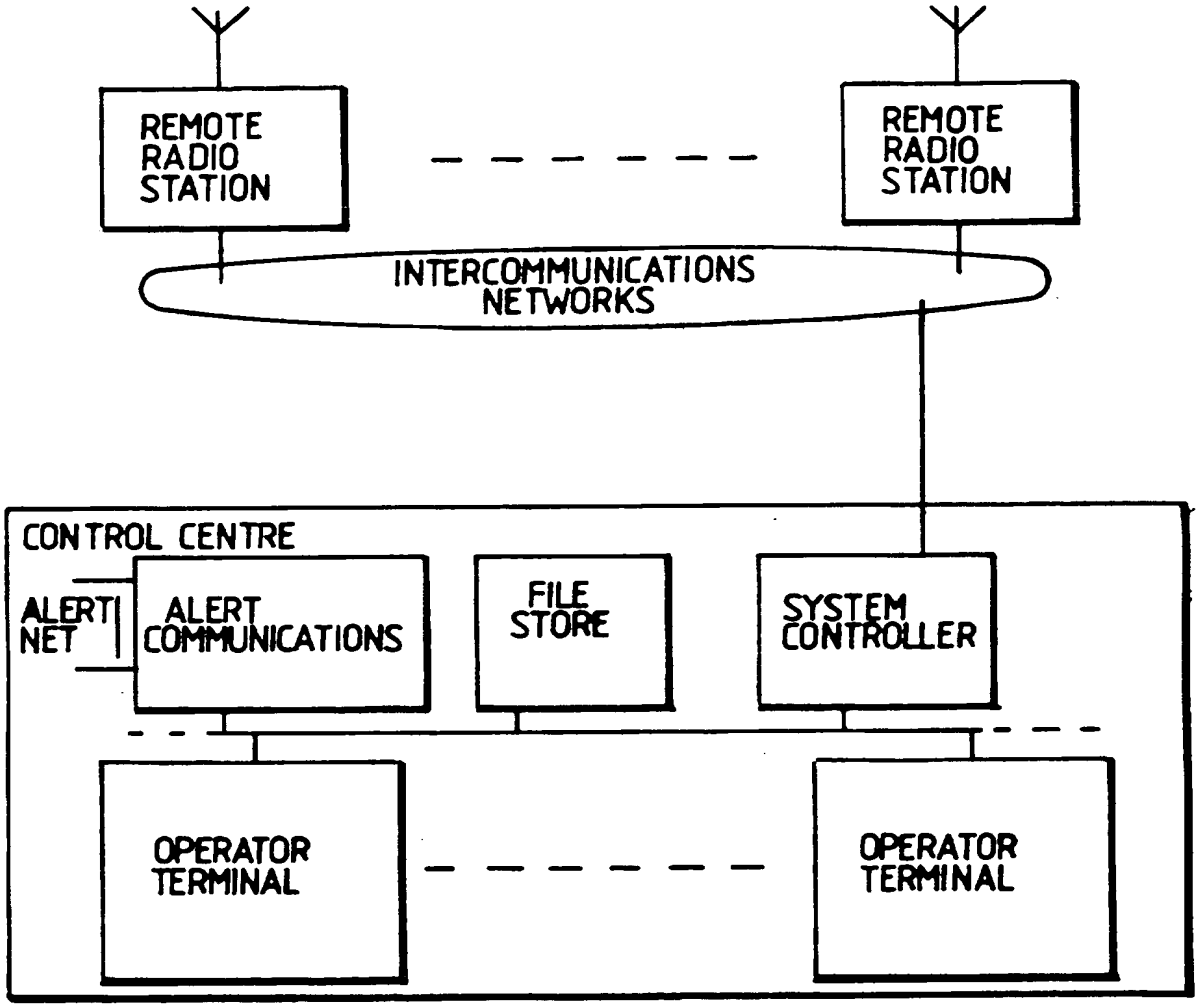

FIG.3

VEHICLE SECURITY SYSTEMS

The invention relates to vehicle security systems.

It is already known to provide vehicles with radio transmitters which are turned on to send signals to a control centre in the event of unlawful entry or use. However in the event of failure of the vehicle alarm, no present arrangement is capable of alerting the unlawful activity or indeed monitoring that a failure has occurred so that the failure can be rectified. As such, present such arrangements lack the absolute security that is required for combating ever increasing vehicle thefts.

It is an object of this invention to overcome or at least reduce this problem.

According to one aspect of the invention there is provided a vehicle security system comprising a control centre and a number of radio stations geographically separated and dispersed in a region to be covered by the system arranged to communicate with vehicles located in the region, in which the control centre is arranged to control transmitters and receivers at the radio stations and to pass and receive messages from the vehicles and to store information about the condition and location of each vehicle, in which the control centre includes a computer that is programmed to interrogate via the radio stations each vehicle at intervals of time and in turn and to

respond immediately to any alarm signals produced by any of the vehicles and received at any one of the radio stations.

According to another aspect of the invention, there is provided a vehicle alarm including a number of sensors to respond to different respective conditions of the vehicle, a GPS receiver for determining the location of the vehicle, a vehicle immobiliser and a receiver and transmitter for communication with radio stations of a security system, in which the receiver is controlled to be in stand-by mode most of the time and synchronised to turn on according to set GPS times so as to respond to predetermined timed signals for the vehicle from the radio transmitters, and in which the transmitter is controlled to send alarm signals immediately any one of the sensors is initiated.

A vehicle security system and vehicle alarm according to the invention will now be described by way of example with reference to the accompanying schematic drawings in which:-

Figure 1 shows the system;

Figure 2 shows the vehicle alarm; and

Figure 3 shows a control and communication arrangement for

the system.

Referring to the drawings, in Figure 1 the system includes a control centre 10 which is coupled to a number of remote radio stations 11 geographically separated and dispersed in a region to be covered by the system. The control centre is arranged to control and organise the radio stations to transmit and receive messages from mobile units 12 that are mounted in respective vehicles.

The system may include a number of repeater or slave radio stations dispersed in the region usually at positions within an area covered by one of the radio stations where radio communications are difficult because of high rise buildings, tunnels and so on. The repeater stations simply respond to and pass on signals they receive to and from a respective radio station.

In operation, the control centre includes one or more computers that are programmed to communicate with each vehicle covered by the system and in particular to send and receive messages at predetermined and set time intervals for each vehicle. The mobile units are normally arranged to exchange message for 30 seconds every 4 hours. At other times the mobile unit is switched to a low power consumption stand-by mode. This is explained further below but such programmes ensure that at all times the system is continually aware of the location and safe

condition of each vehicle. The radio stations and mobile units are capable of transmitting signals by time division or frequency division multiplexing. Should any mobile unit or communication between the control centre and the mobile unit become unserviceable, the control centre is alerted at least at the next set time for the exchanges of information for that mobile unit. This means that the system and the mobile units are continually checked for malfunctions and remedial action can be initiated. Hitherto mobile units could fail or communication links become unserviceable without the knowledge of the control centre or the vehicle owner leaving a vehicle exposed and unsecured for intrusion or authorised use indefinitely or until the failure become otherwise identified. The control centre and mobile units are synchronised by a global clock pulses and each mobile unit includes a GPS receiver to respond to such clock pulses.

In the event of an alarm being initiated at the vehicle, the system is arranged so that any alarm signals are immediately recognised at the control centre even if the alarm occurs at a time non-coincident with the set times for normal exchanges.

In Figure 2, a mobile control unit 14 includes various components including a vehicle immobiliser such as an ignition or fuel cut-out, vehicle sensors (for example responding to any motion of the vehicle, tampering with

doors or windows, tampering with a vehicle aerial, disconnecting the vehicle battery and so on), a local audible alarm generator, and a communicator with a keypad for use by an authorised driver to immobilise the sensors and/or identify his authority to use the vehicle. Such components are generally known per se.

The mobile control unit also includes a GPS receiver to receive global clock pulses and enable the mobile unit to identify its geographical location. A radio receiver is included to receive signals from the radio stations, and two transmitters to send signals to the radio stations. One transmitter is used in practice for exchanging information with the control centre via the radio stations. Special messages can be sent by using the keypad. The other transmitter is used to generate alarm signals for the system in the event of intrusion or unauthorised use of the vehicle. Usually the other transmitter is provided with a separate battery or power supply (which is kept fully charged by the vehicle battery or charging circuit) so that the other transmitter can be powered independently in cases of emergency, for example when the vehicle battery is isolated or otherwise tampered with.

Thus, the vehicle security system consists of a control centre, radio stations and one mobile unit in each vehicle. The control centre provides the centralised

monitoring and control of the system. The radio stations are geographically situated to cover the complete area over which protection is provided and are normally connected to the control centre by an intercommunication network. The complete system is modular and two or more systems can be interconnected and operate together. In such a case, information about each vehicle is stored in its "home" file store. Should this information be required by another system then it can be obtained by communication through intersystem links.

In each vehicle a mobile unit consists of a central control unit, one (or more) communication receivers, two (or more) communication transmitters, a collection of sensors to evaluate the vehicles status, a vehicle position determining unit (a GPS receiver) and a vehicle immobiliser and access controller. The number of transmitters and receivers are determined by the number of communication channels available for the system to use. The central control unit controls the operation of the complete mobile unit receiving and sending messages using the communication receivers and transmitters, monitoring the vehicle status using the sensors, including any other vehicle security alarm, and ensuring that only authorised users may start the vehicle engine by controlling a vehicle immobiliser, such as an ignition cut off switch.

A pager unit can be provided in the vehicle that will

display messages sent to the mobile unit, each character code is preferably 16 bits and therefore can support languages including Chinese. Each mobile unit has a unique identity code built into it, if any message is received by the system labelled with the mobile unit's identity code and with a correct checksum then it is acted upon.

The overall communication installation may be quite extensive because the radio stations are capable of sending messages to, and receiving messages from, the mobile units. These stations are positioned to provide coverage over the area within which the vehicles are to be protected and are connected to the control centre via the intercommunication network. In addition to the messages that they receive from the mobile units the radio stations can send information to the control centre about their own operational status to assist in faultfinding. The control centre receives and collects all of the messages that are received by the system. To prevent the loss of messages a network protocol for passing data ensures that a complete copy of the information that is being passed form one section of the network system to another can always be stored in at least two separate computers. The intercommunication network is arranged so that the messages always have more than one path to follow to reach a given destination. All stations on the network have a unique address code and it is this address together with

software in the computers that are connected to the network which routes the messages to their appropriate destination. Each communication link is periodically tested with a dummy message to allow the system to diagnose communication link failures. The routing chosen is calculated using a costing table that is situated at each computer on the network, should the lowest cost route fail to provide the connection required then, in ascending cost, other routes are attempted until a connection is established. These tables can be changed remotely to allow for the addition of communications links to the network or they can be updated automatically by requesting the unit to poll the units it has a direct connection with. The control centre sends information to each of the remote communication stations about which mobile units should be contacted.

The control and communication arrangement is shown in Figure 3 and consists of a file store which is a distributed fault tolerant unit with rollback that keeps the overall state of the complete system and can be used to restore the systems previous state after a failure. A system controller is included that sends and receives all messages communicating with the remote communication stations and determining the operating mode of the communication system. An alert communications controller communicates with the local law enforcement agencies to disseminate vehicle alarm information. An operator

terminal allows alarms to be acted upon and vehicles to be tracked and displayed on a map. All of these units may be duplicated if required.

In operation, if a mobile unit should detect a condition it has been programmed to provide an alert for (i.e. power failure, vehicle alarm, etc) then a message is sent to a radio station that is covering the area the vehicle is located in. The message is continually resent on a regular basis until the system sends an acknowledgement message to confirm receipt of the message. This acknowledgement and message repeating prevent the loss of a message due to interference in the communication channel and ensures that a message has been passed on to another module in the system before the state at the sending module is cancelled. As the alarm is an asynchronous message a separate communications transmitter or channel is allocated to alarms and is continually monitored by the radio stations.

In the mobile stations, when the vehicle is active and the battery is charging then there is no requirement to save power and the mobile unit is fully active. After a short time of the battery not charging the mobile unit "sleeps", the sleep mode requires very little power. In sleep mode the vehicle sensors and alarms remain active. At preprogrammed times the unit will awake, reconfirm its position and monitor the communication channels to

determine if it is being communicated with. The times when each mobile unit will wake up are stored within the control centre file store and are used to calculate when an attempt should be made to communicate with a mobile unit to poll its status for system housekeeping and diagnostic purposes. If an alarm condition is identified then the mobile units wake up automatically and send respective alarm messages.

The system must not lose messages due to the failure of a single computer, therefore the data transfer mechanism is arranged so that any message being sent from a remote communication station to the control centre is duplicated within each computer it passes through until it arrives at the file store. Once the message is stored at the file store it is safe and at that point an acknowledgement message is sent to erase the copies of data. All messages are allocated a unique number that can be used to determine from where they originated, the acknowledgement message contains this number and only copies of messages with the same number will be deleted.

The system allows replacement of computers within the system without interrupting its operation. All modules of the system that have a direct connection to the file store retain a copy of their state in the file store. Should a computer fail then the addition of another computer with the same identity will cause the software to continue from

the state that was previously saved. An audit trail of states is saved for each computer and the most recent valid state is used. All important system states are kept in the file store. If a unit such as a radio station fails the replacement unit will request its state from the control centre before continuing. However, all units not directly connected to the file store, via the local control centre network, are stateless where possible. The complete system allows distributed processing and therefore additional units can be added to increase the processing power of the system and to protect against the effect of the failure of a single unit. This allows operator terminals to be conveniently added or removed from the system at any time.

The system is arranged to prevent a vehicle from being unprotected due to a failure of its on board mobile unit. The wide area over which the system can operate and the large number of vehicles it can protect generally makes a planned maintenance scheme impractical. The system periodically polls each mobile unit, this continues even when the mobile unit is in "sleep" mode and is therefore timed to coincide with the mobile units wake up times. The poll checks the mobile unit and reports any failures or malfunctions. Should a malfunction be detected or a mobile unit fail to reply then a maintenance check can be made.

The communications arrangements are devised to initially use Time Division Multiplexing (TDM) but are generally designed to use Frequency Division Multiplexing (FDM) signals as well. A problem of using TDM signals is that adjacent remote communications stations cannot transmit messages without interfering with each other and therefore the number of radio stations that can simultaneously communicate with mobile units is small. FDM signals allow adjacent remote communication stations to transmit simultaneously using different communication channels. To support this, additional transmitters have to be provided in the mobile unit and additional transmitters in the remote communication stations.

For on-going arrangements therefore provision for both TDM and FDM signals is made. All mobile units and radio stations (FDM and TDM) are provided with the appropriate receivers and transmitters to support an TDM system. All units can therefore be used in TDM mode. The additional channels that are available for each mobile unit are stored in the file store at the control centre. To synchronize the system to prevent two remote communication stations from interfering with each other all requests to transmit are time stamped with their transmission time and each remote communication system is synchronised to an external clock (i.e. clock signals received by a GPS receiver). The pattern of message requests that can be sent out is determined by a set of templates stored in the

file store. The templates show which radio stations can transmit simultaneously for a given set of communication channels. In the case of a pure TDM system there will be one template for each remote communication station with a single remote communication station enabled for transmission in each template. (However, in practice radio stations that are far enough apart can usually transmit on the same communication channel at the same time) For the FDM system there are fewer templates with more remote communication stations enabled in each. In an ultimate FDM system with enough communications channels, there is only one template with all remote communication stations enabled. The system controller at the control centre matches the best set of templates to communicate with the mobile stations it is intending to contact and then uses these to control the sending pattern and communication channels of the radio stations. The messages sent from the system controller to the radio stations contain the identity code of the mobile unit to contact, the time stamp (according to the vehicles GPS time slot) of when to attempt the contact and the communication channel to use. This flexible scheme of templates, time stamped transmission schedules and synchronization with a global clock provides flexibility to incorporate both TDM and FDM systems.

It will be appreciated that provided all mobile units in all systems have a basic TDM system and support the same

communications channels, then all vehicles can be communicated with in a system which combines two systems brought together which were previously separated. Part of the vehicle identity code determines its "home" system and this can be used by a combined or interconnected system to request the necessary vehicle details as required.

CLAIMS

1. A vehicle security system comprising a control centre and a number of radio stations geographically separated and dispersed in a region to be covered by the system arranged to communicate with vehicles located in the region, in which the control centre is arranged to control transmitters and receivers at the radio stations and to pass and receive messages from the vehicles and to store information about the condition and location of each vehicle, in which the control centre includes a computer that is programmed to interrogate via the radio stations each vehicle at intervals of time and in turn and to respond immediately to any alarm signals produced by any of the vehicles and received at any one of the radio stations.

2. A system according to claim 1, including a number of repeater stations dispersed within the region.

3. A system according to claim 1 or 2, radio communications are time division multiplexed signals.

4. A vehicle alarm including a number of sensors to respond to different respective conditions of the vehicle, a GPS receiver for determining the location of the vehicle, a vehicle immobiliser and a receiver and transmitter for communication with radio stations of a

security system, in which the receiver is controlled to be in stand-by mode most of the time and synchronised to turn on according to set GPS times so as to respond to predetermined timed signals for the vehicle from the radio transmitters, and in which the transmitter is controlled to send alarm signals immediately any one of the sensors is initiated.

5. A vehicle alarm according to claim 4, including a separate transmitter for providing the alarm signals.

6. A vehicle alarm according to claim 4 or 5, including an internal battery arranged to be charged by a battery of the vehicle.

7. A vehicle alarm according to claim 5, in which the transmitter is arranged to send alarm signals if the vehicle battery supply to the internal battery is disrupted.

8. A vehicle security system substantially as herein described with reference to the accompanying drawings.

9. A vehicle alarm substantially as herein described with reference to the accompanying drawings.

Amendments to the claims have been filed as follows

CLAIMS

1. A vehicle security system comprising a control centre and a number of radio stations geographically separated and dispersed in a region to be covered by the system arranged to communicate with vehicles located in the region, in which the control centre is arranged to control transmitters and receivers at the radio stations and to pass and receive messages from the vehicles and to store information about the condition and location of each vehicle, in which the control centre includes a computer that is programmed to interrogate via the radio stations each vehicle at respective dispersed set GPS times in turn and to respond immediately to any alarm signals produced by any of the vehicles and received at any one of the radio stations.

2. A system according to claim 1, including a number of repeater stations dispersed within the region.

3. A system according to claim 1 or 2, in which radio communications in the system are time division multiplexed signals.

4. A vehicle alarm for the system according to claim 1 including a number of sensors to respond to different respective conditions of the vehicle, a GPS receiver for determining the location of the vehicle, a vehicle

immobiliser and a receiver and transmitter for communication with radio stations of the security system, in which the receiver is controlled to be in stand-by mode most of the time and synchronised to turn on according to respective set GPS times so as to respond to predetermined timed signals for the vehicle from the radio transmitters, and in which the transmitter is controlled to send alarm signals immediately any one of the sensors is initiated.

5. A vehicle alarm according to claim 4, including a separate transmitter for providing the alarm signals.

6. A vehicle alarm according to claim 4 or 5, including an internal battery arranged to be charged by a battery of the vehicle.

7. A vehicle alarm according to claim 5, in which the transmitter is arranged to send alarm signals if the vehicle battery supply to the internal battery is disrupted.

8. A vehicle alarm according to nay of claims 4 to 7, incorporating a pager.

9. A vehicle alarm according to any of claims 4 to 8, incorporating message sending and receiving facilities for use with communication installation comprised by the security system.

10. A vehicle security system substantially as herein described with reference to the accompanying drawings.

11. A vehicle alarm substantially as herein described with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9507274.0
Relevant Technical Fields (i) UK Cl (Ed.O) G4H (HNEC, HNEE, HNEM) (ii) Int Cl (Ed.6) B60R 25/10	Search Examiner M J DAVIS Date of completion of Search 6 MARCH 1996
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-3, 8

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2268818 A	(HARTBROOK)	1-3 at least
X	GB 2237707 A	(SECURITY ALERT)	1-3 at least
X	US 4651157	(GRAY ET AL)	1-3 at least

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